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# WARTIME REPORT

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## PRESSURE-DISTRIBUTION MEASUREMENTS OF A MODEL OF A DAVIS WING SECTION WITH FOWLER FLAP SUBMITTED BY CONSOLIDATED AIRCRAFT CORPORATION

By Ira H. Abbott

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Langley Field, Va.



NACA

WASHINGTON

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for

Materiel Division, Army Air Corps

L-676

PRESSURE-DISTRIBUTION MEASUREMENTS OF A MODEL OF A

DAVIS WING SECTION WITH FOWLER FLAP SUBMITTED BY

CONSOLIDATED AIRCRAFT CORPORATION

By Ira H. Abbott

## INTRODUCTION

Pressure-distribution measurements were made at the request of the Materiel Division, U.S. Army Air Corps, on a 24-inch chord model equipped with a Fowler flap and submitted by the Consolidated Aircraft Corporation. The tests were made in the Langley two-dimensional tunnel at a Reynolds number of about 6,000,000.

The model is of a section of the Davis wing for the XB-38 airplane and is described in reference 1. The tubes for the pressure orifices in the flap were removed for the tests of reference 1 to prevent possible interference with the flow through the slot. These tubes were replaced for the pressure-distribution tests in essentially the same manner as when received except that smaller diameter tubes were used to minimize possible interference effects.

## RESULTS AND DISCUSSION

Pressure-distribution diagrams for several angles of attack, and flap deflections of 0°, 20°, and 40° are presented in figures 1 to 16. Pressures are plotted directly as obtained from the manometer in terms of 1/2-inch units of carbon tetrachloride. The abscissa is the measured projection on the chord line of the pressure orifices. The values of the corrected dynamic pressure q and the impact pressure level in terms of the same units are given on each figure. The static pressure level is obtained by adding the value of q to the impact pressure level. The value $\left(\frac{v}{V}\right)^2$, where v is the local velocity and V is the free-stream velocity, is obtained by dividing the local pressure, measured from the impact pressure level, by the value of q.

The normal-force coefficient $C_N$, as obtained by integration of the pressure diagrams, is given on each figure. These normal-force coefficients are in reasonable agreement with the lift coefficients presented in reference 1 except near the maximum lifts with flap deflected. The present tests indicate lower values of the maximum lift coefficient than those presented in reference 1 and this is thought to be caused by the interference of the pressure tubes on the flap. At each flap deflection the pressure distribution presented at the highest angle of attack was taken at or very close to maximum lift.

Moment coefficients about the quarter-chord point $C_{m_{c/4}}$ are also presented as obtained by integration of the diagrams. These moment coefficients do not contain the component of moment due to the chord force which may be appreciable, especially for the flap-deflected conditions. This component of moment may be obtained by replotting the diagrams against displacement of the orifices perpendicular to the chord.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., January 17, 1942.

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## REFERENCE

1. Abbott, Ira H., and Turner, Harold R., Jr.: Lift and Drag Tests of Three Airfoil Models with Fowler Flaps Submitted by Consolidated Aircraft Corporation. NACA MR, Dec. 29, 1941.

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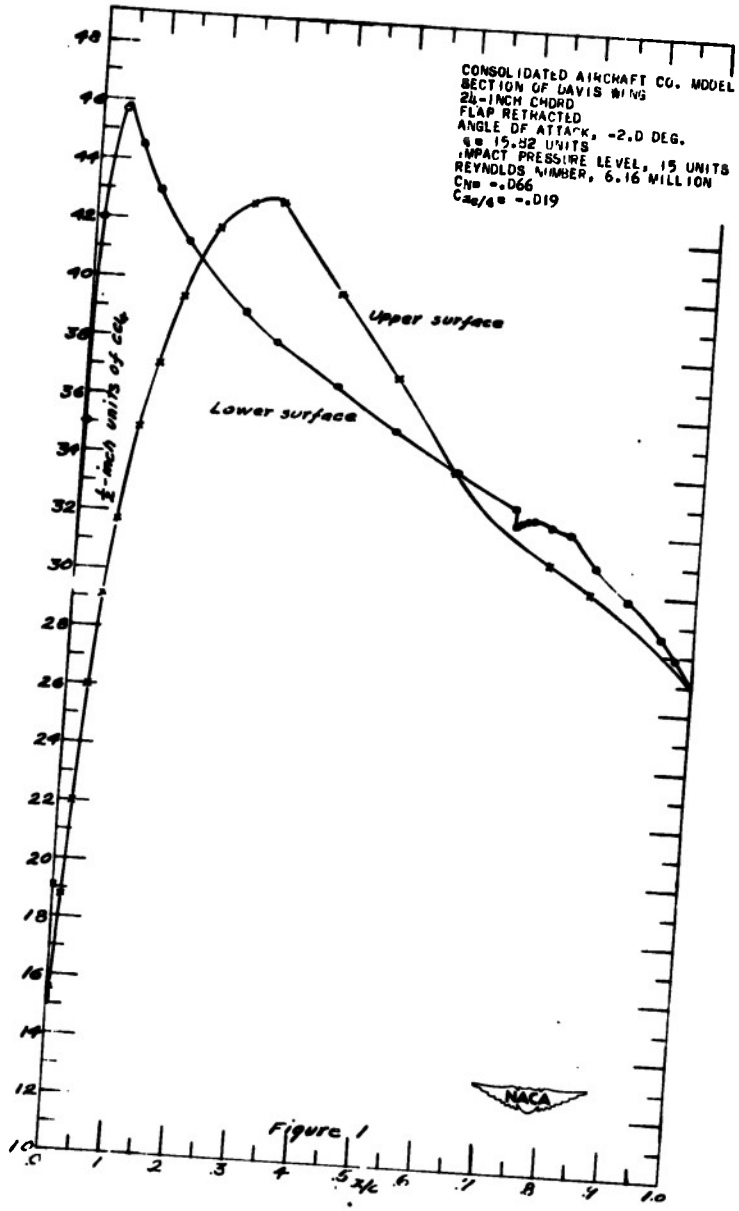


Figure 1

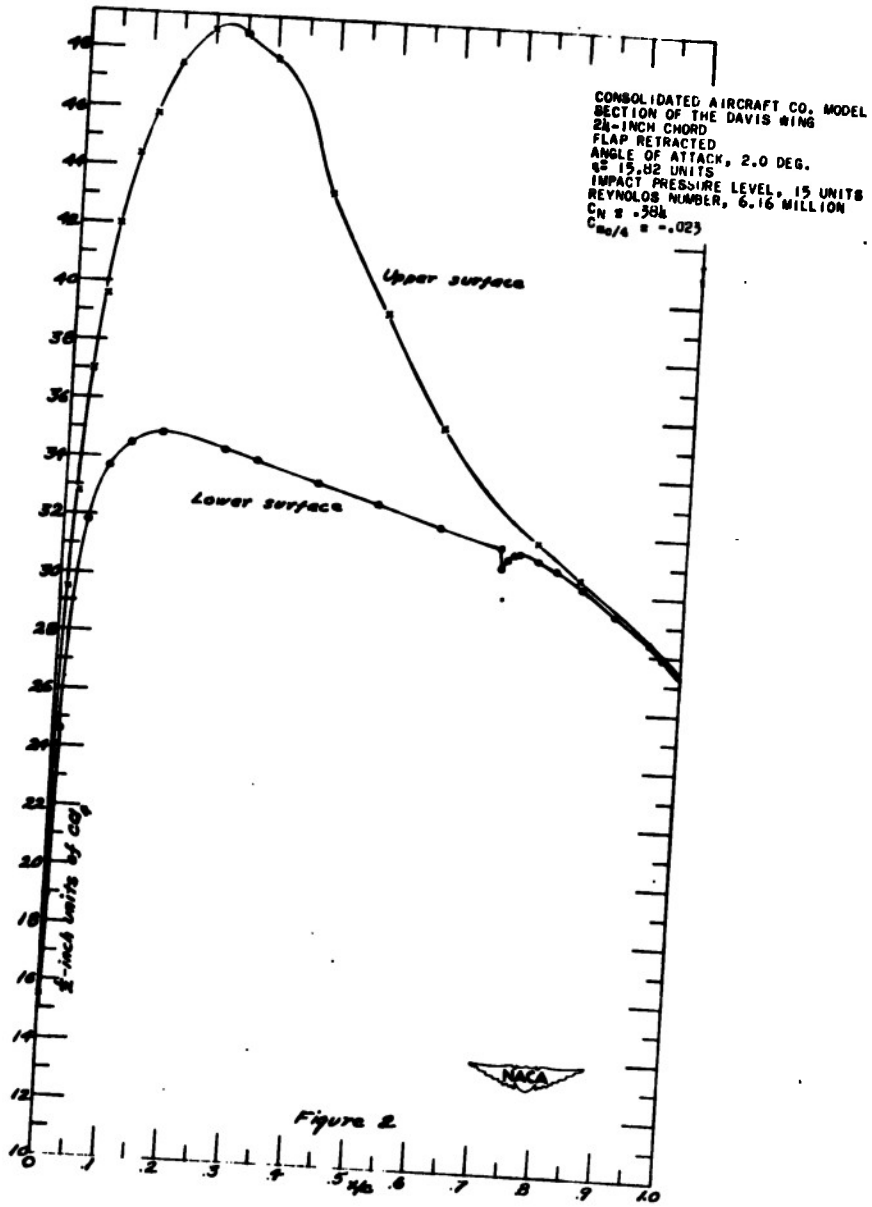
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF THE DAVIS WING
24-INCH CHORD
FLAP RETRACTED
ANGLE OF ATTACK, 2.0 DEG.
qE 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.16 MILLION
$C_N$ = .584
$C_{m_{c/4}}$ = -.023
Upper surface
Lower surface
2-inch units of c
NACA
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0

Figure 2.

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CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP RETRACTED
ANGLE OF ATTACK, 4.1 DEG.
$q$, 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.16 MILLION
$C_N$= .591
$C_{m_{c/4}}$ = -.024

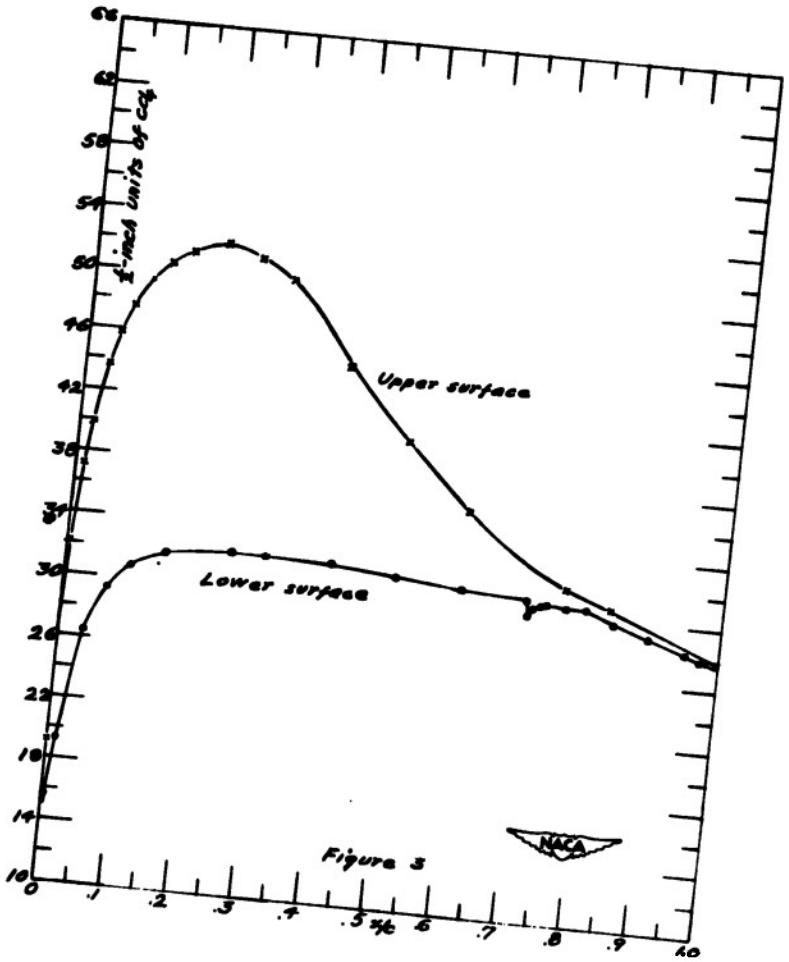


Figure 3

CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP RETRACTED.
ANGLE OF ATTACK, 6.1 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.16 MILLION
$C_N$ = .791
$C_{m_{c/4}}$ = -.025

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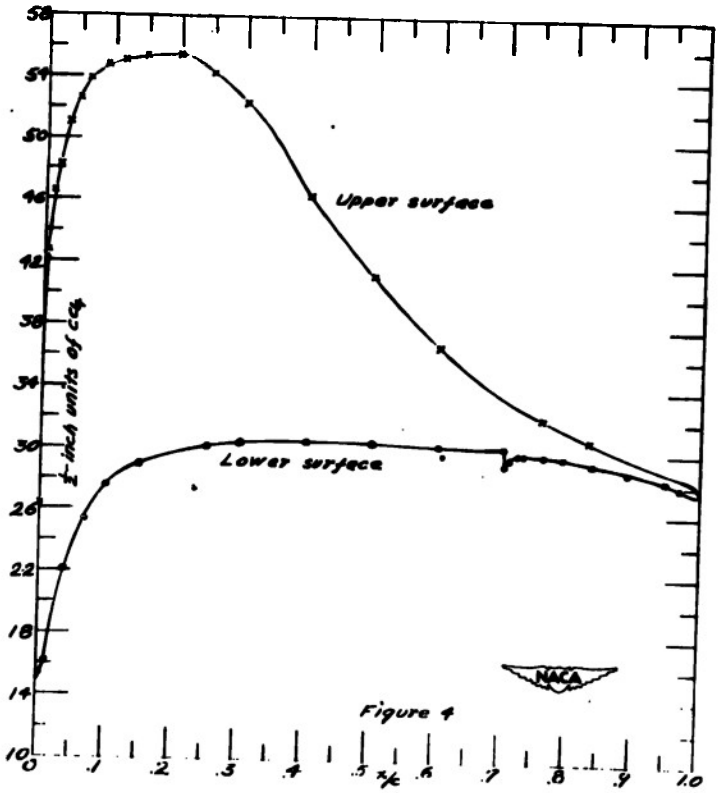



Figure 4

CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP RETRACTED
ANGLE OF ATTACK, 8.1 DEG.
q_c 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.16 MILLION
$C_N$ = .991
$C_{m_{c/4}}$ = -.026

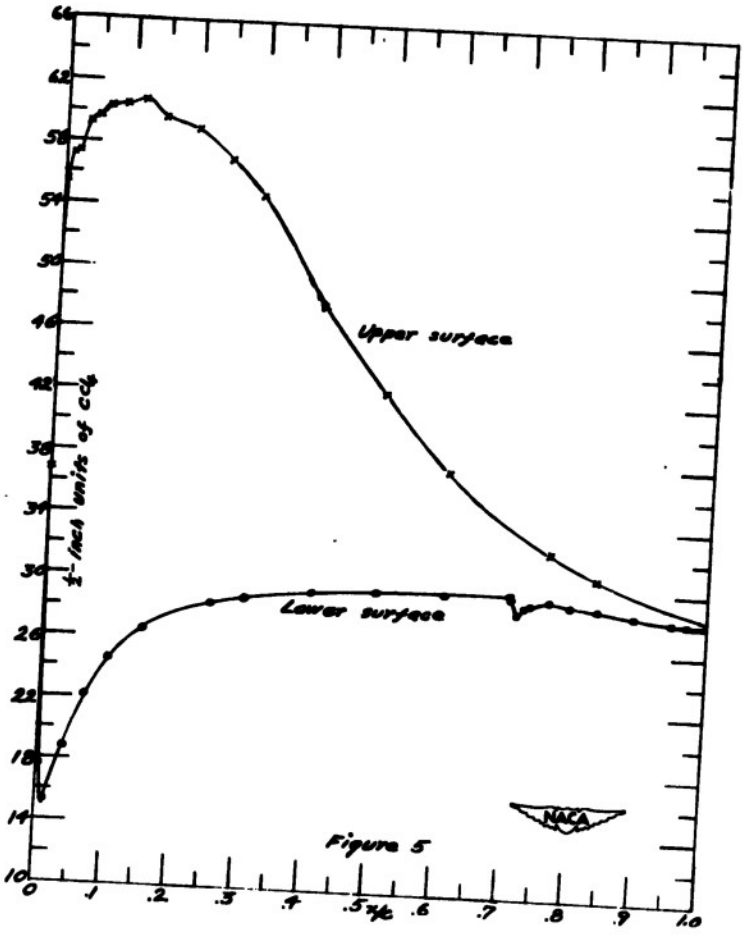
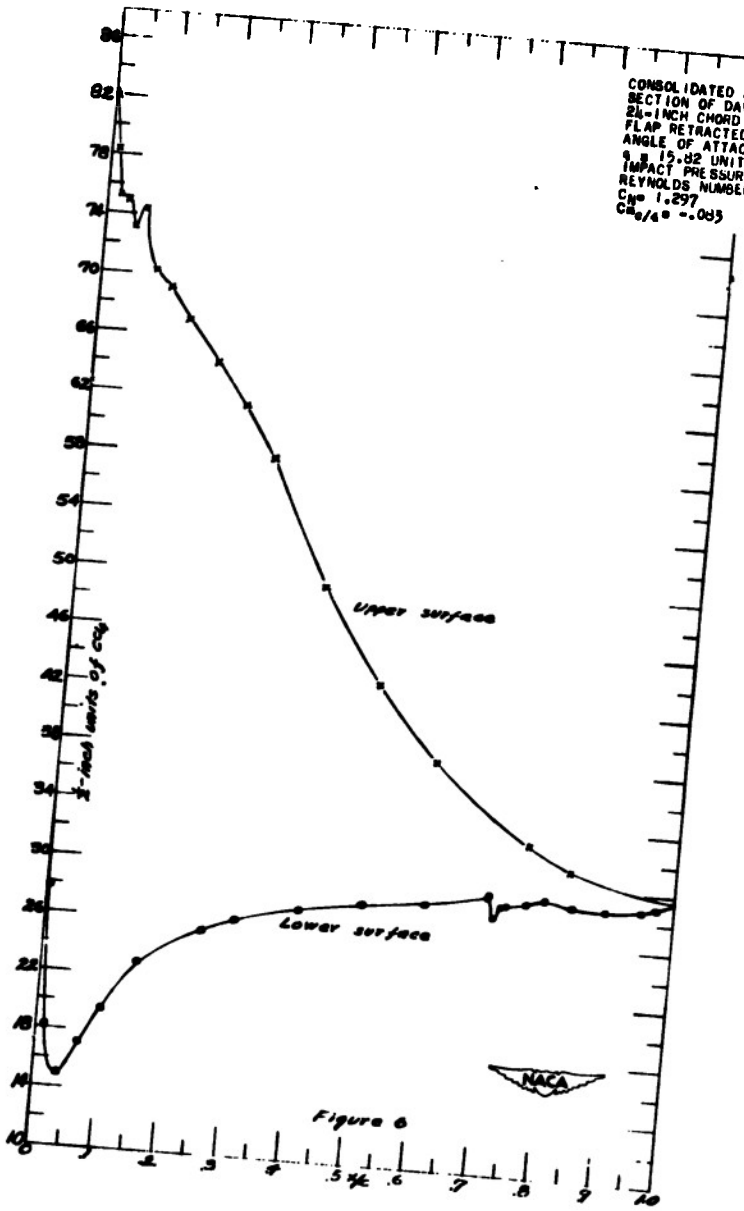



Figure 5


CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP RETRACTED
ANGLE OF ATTACK, 12.2 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.13 MILLION
$C_N$= 1.297
$C_{m_{c/4}}$ = -.083
Upper surface
Lower surface
NACA
Figure 6

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CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 20 DEG.
ANGLE OF ATTACK, -3.1 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.13 MILLION
$C_N$ = -.067
$C_{m_{c/4}}$ = -.175

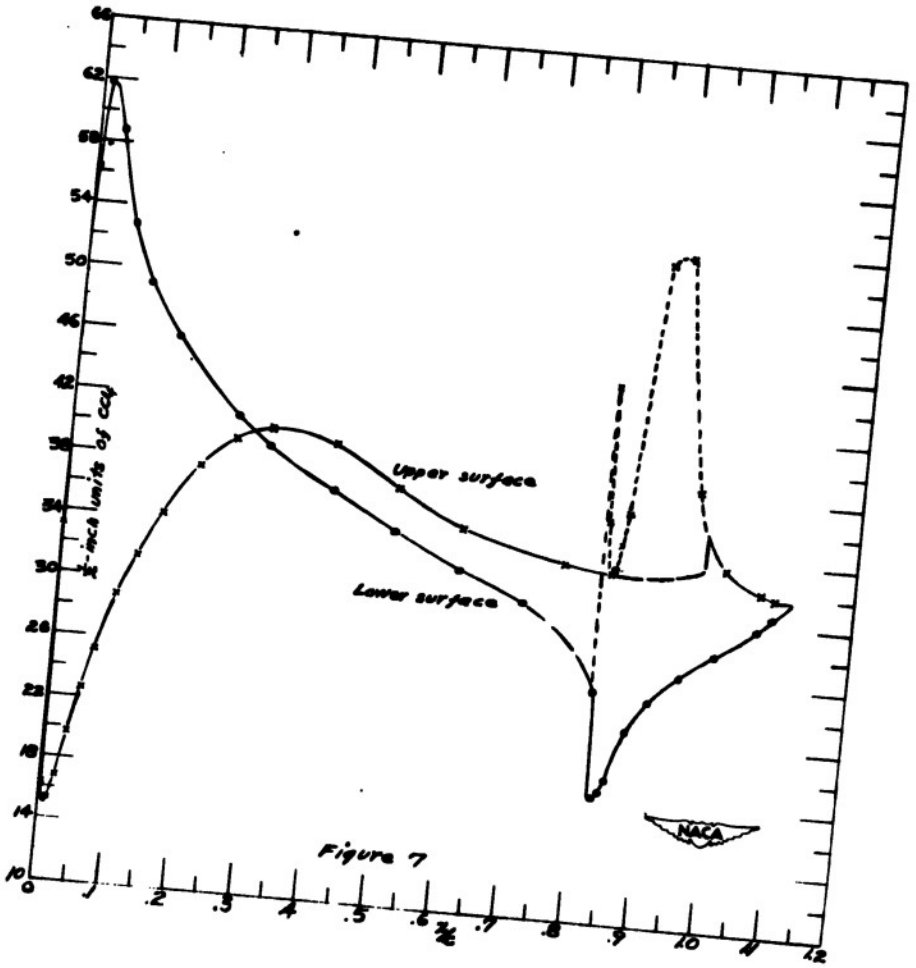


Figure 7

CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 20 DEG.
ANGLE OF ATTACK, -2 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15 MILLION
$C_N$ = .683
$C_{m_{c/4}}$ = -.185

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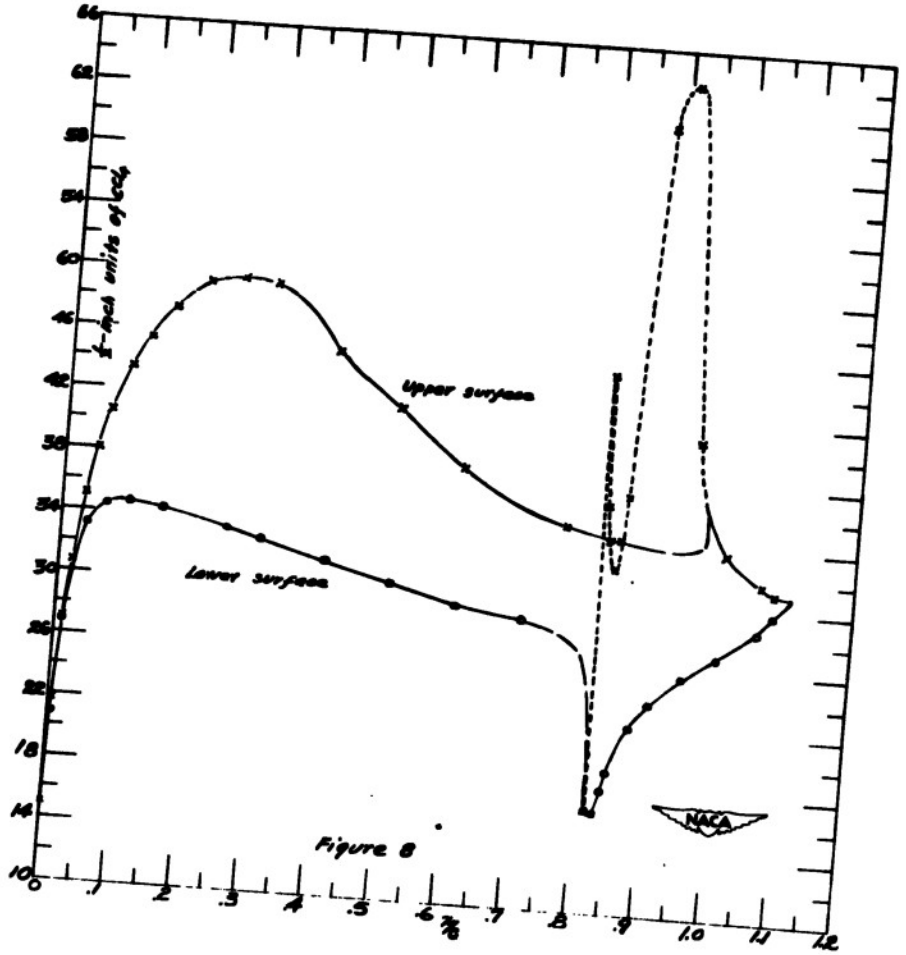


Figure 8

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CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 20 DEG.
ANGLE OF ATTACK, 4.1 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15 MILLION
$C_N$= 1.413
$C_{m_{c/4}}$ = -.226

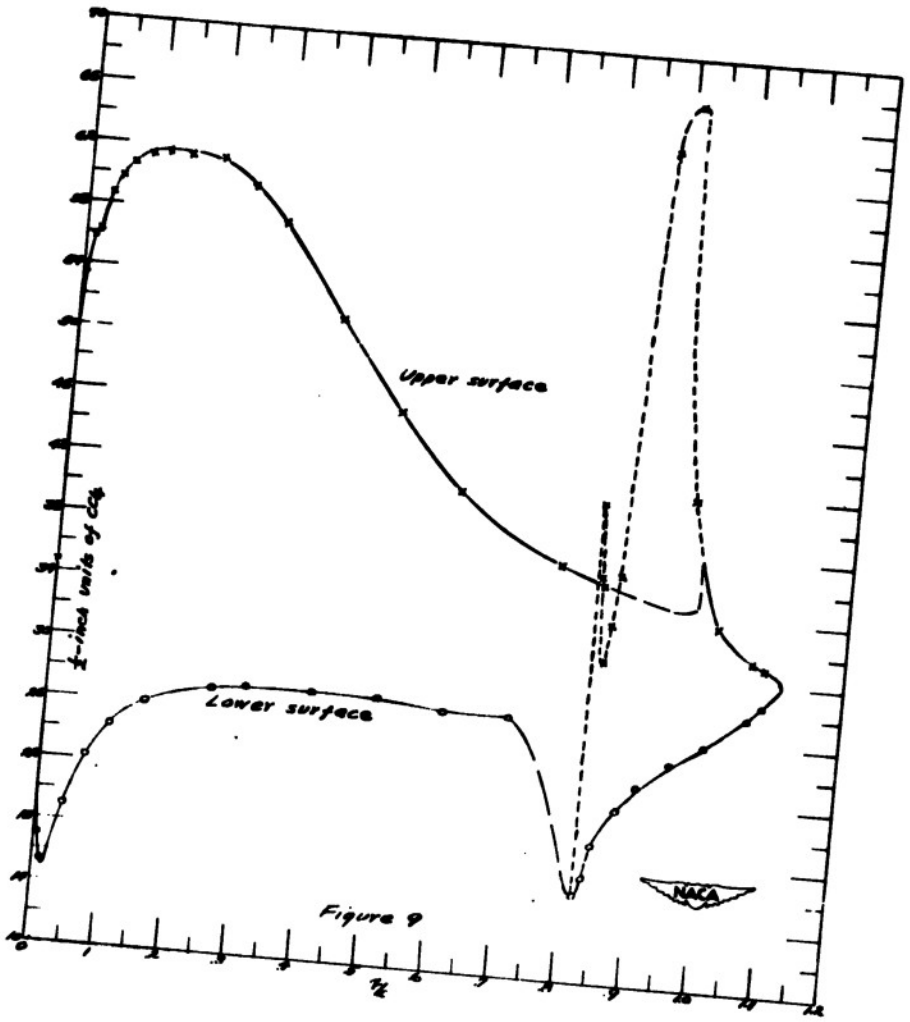


Figure 9

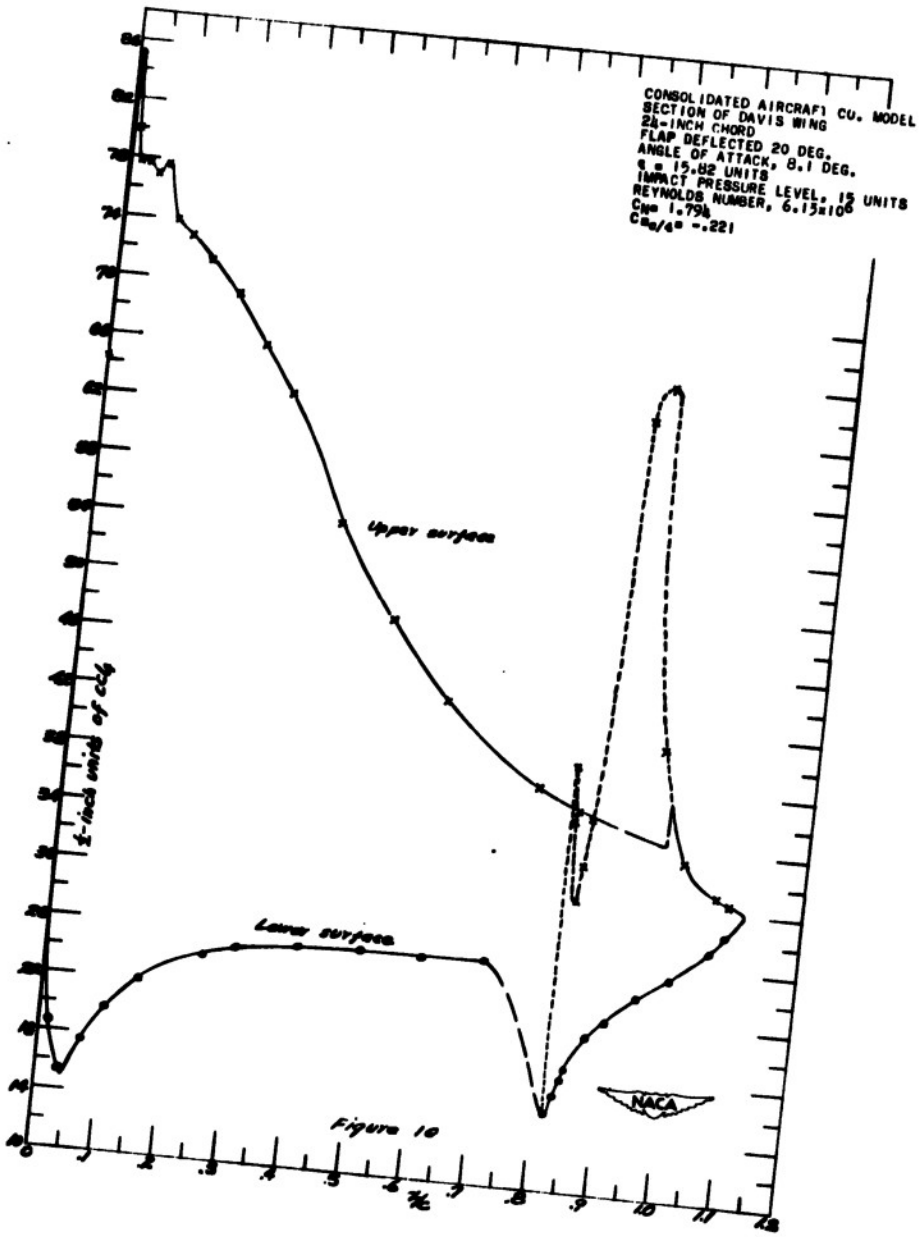
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
28-INCH CHORD
FLAP DEFLECTED 20 DEG.
ANGLE OF ATTACK, 8.1 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15x10^6
Cm= 1.794
Cm/4° -.221
Upper surface
Lower surface
1-inch unit of chord
NACA

Figure 10

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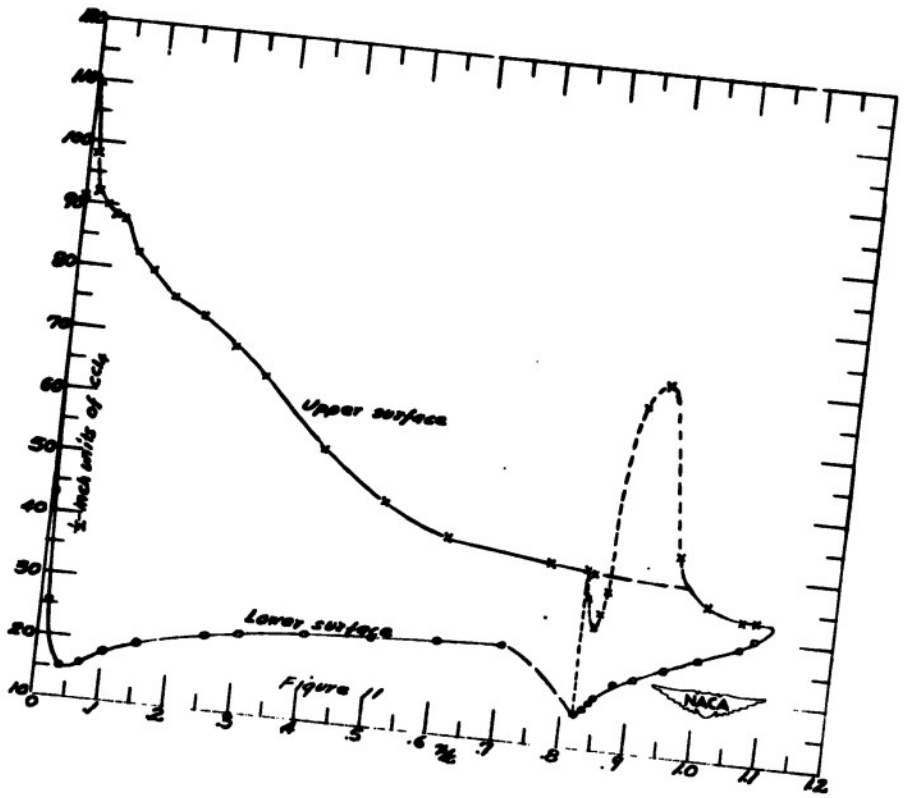
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 20 DEG.
ANGLE OF ATTACK, 12.3 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.08×10⁶
$C_m = 1.979$
$C_{m_{c/4}} = -.251$



CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 40 DEG.
ANGLE OF ATTACK, -17.5 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, $6.16 \times 10^6$
$C_N = -.294$
$C_{m_{c/4}} = -.590$

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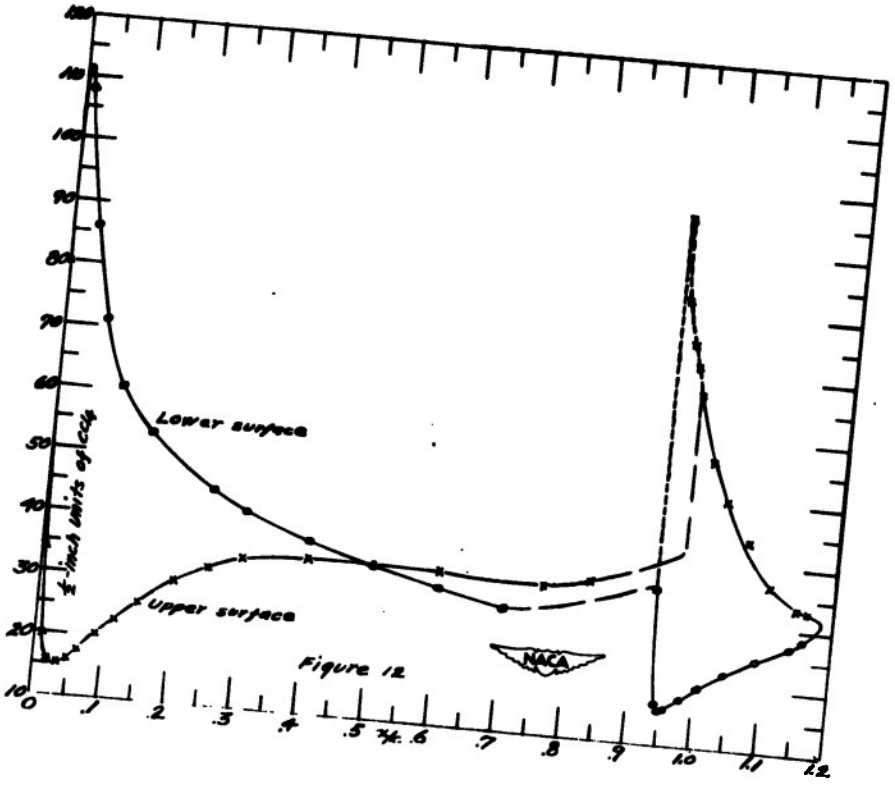


Figure 12

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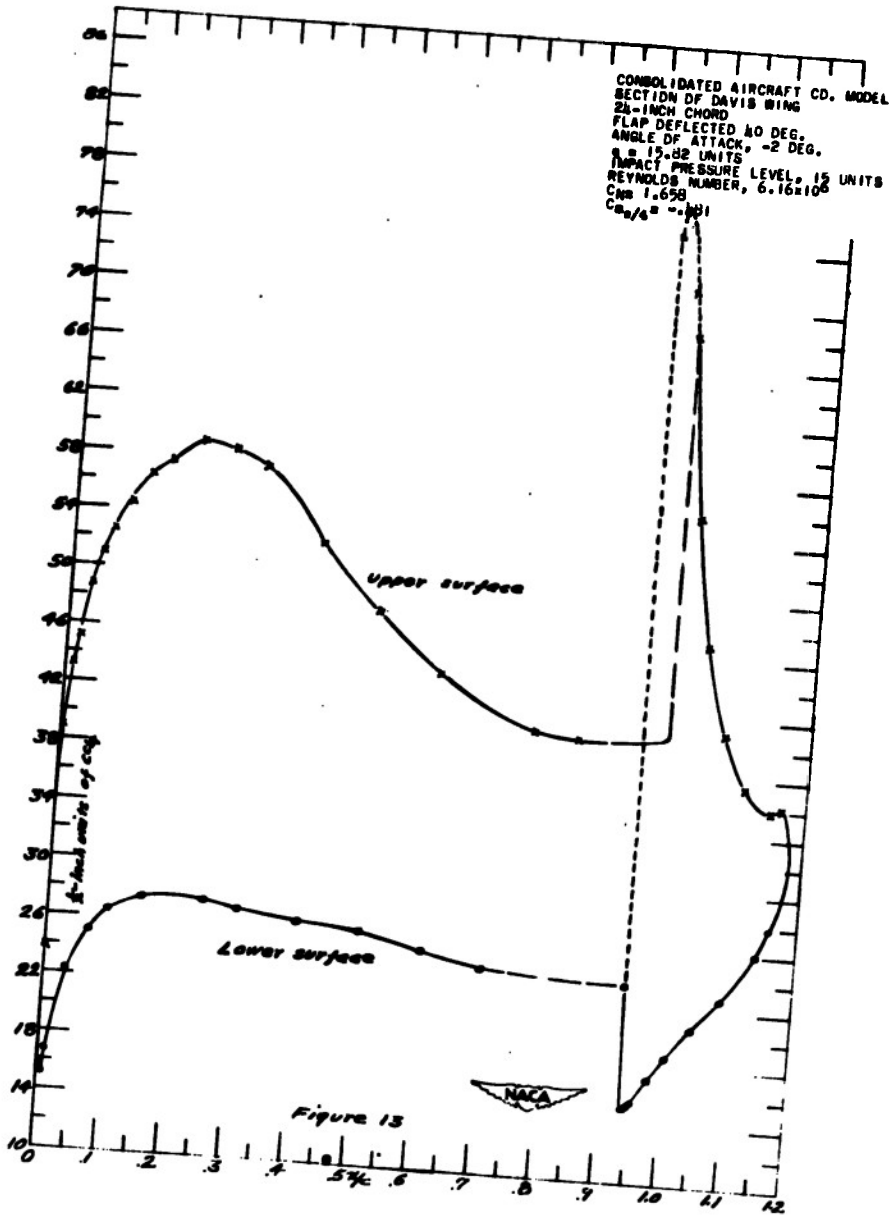
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 40 DEG.
ANGLE OF ATTACK, -2 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.16x10^6
Cm 1.658
Upper surface
Lower surface
NACA
Figure 13

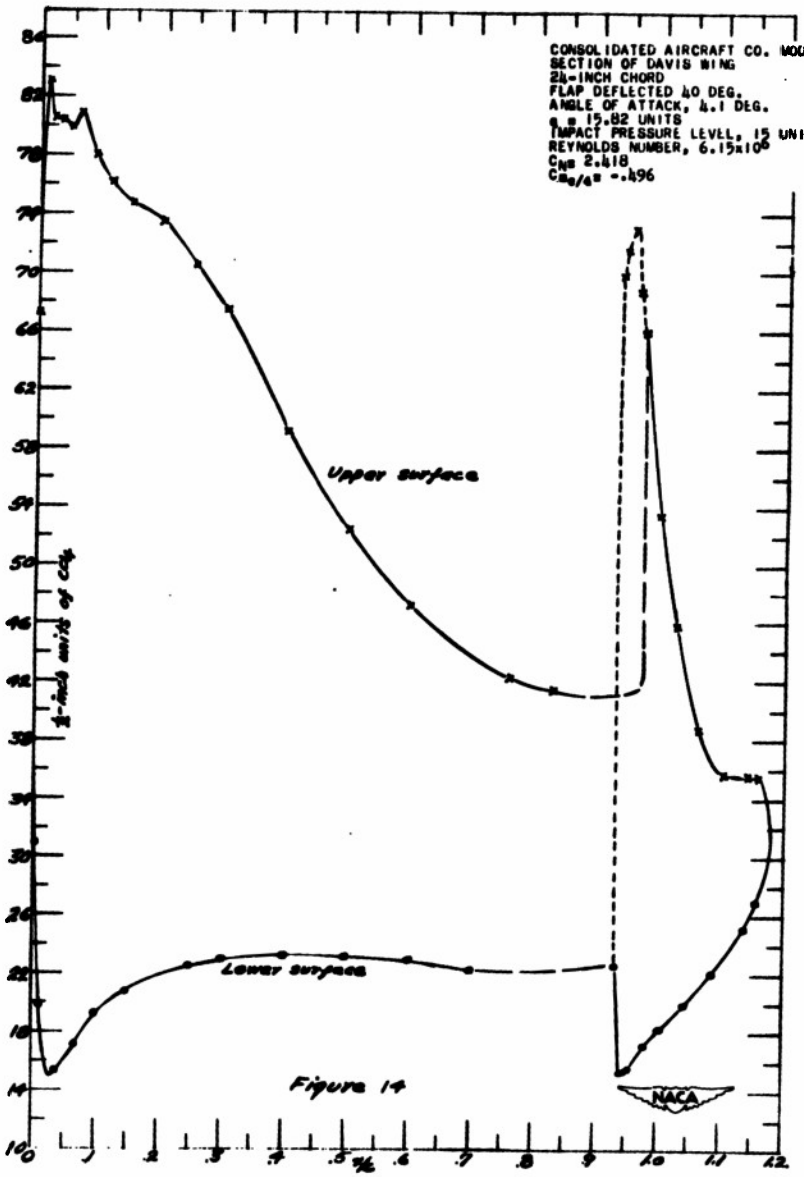
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 40 DEG.
ANGLE OF ATTACK, 4.1 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15x10^6
C_N = 2.418
C_m c/4 = -.496
Upper surface
Lower surface
1-inch units of c/c
NACA

Figure 14

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CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 40 DEG.
ANGLE OF ATTACK, 8.1 DEG.
Q.S. 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15 x10^6
$C_m$= 2.725
$C_{m_{c/4}}$= -.501

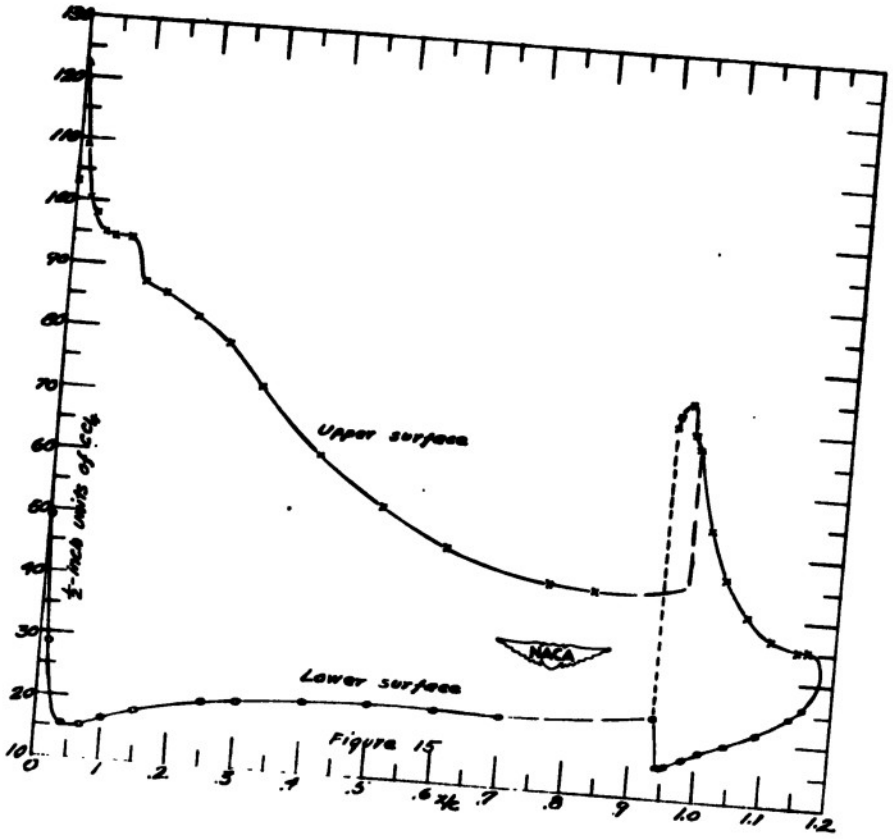


Figure 15

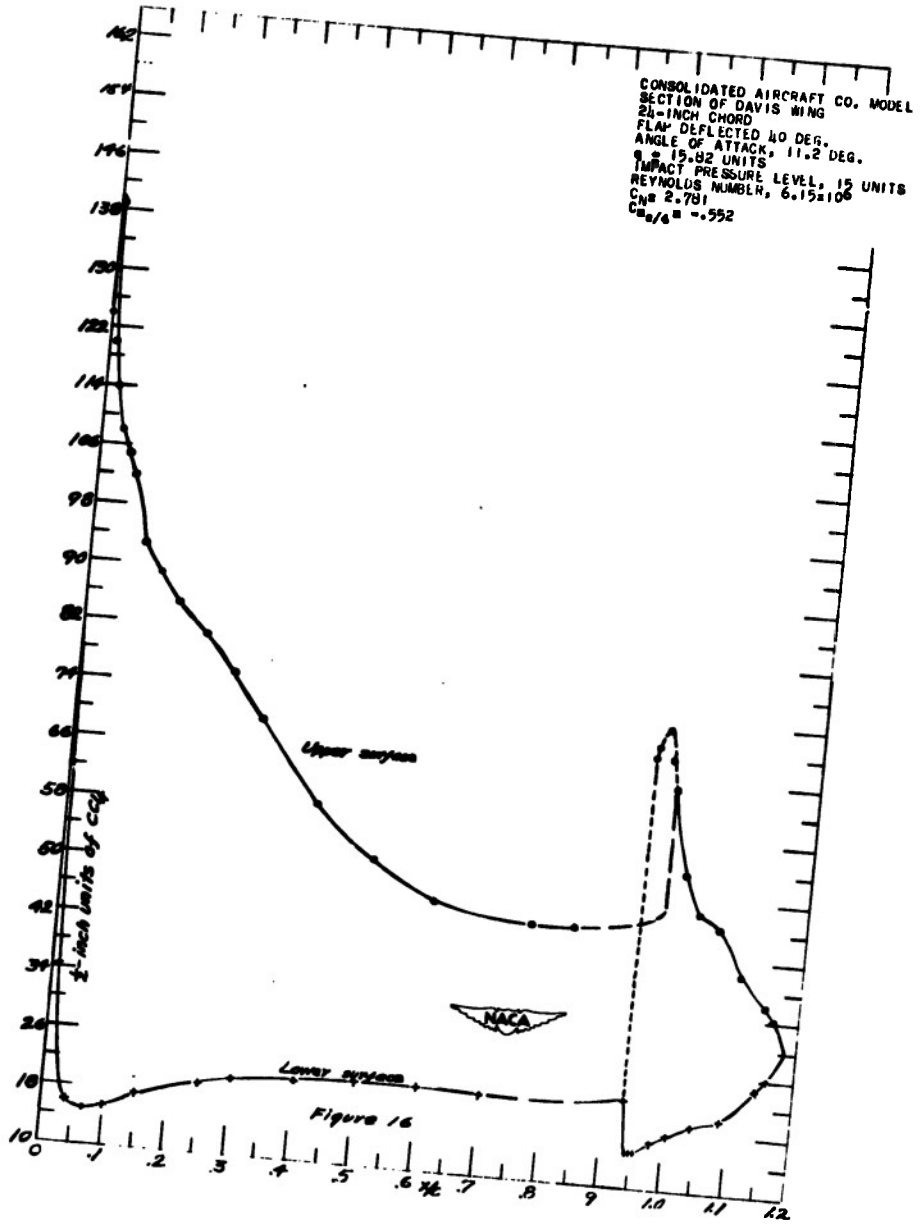
CONSOLIDATED AIRCRAFT CO. MODEL
SECTION OF DAVIS WING
24-INCH CHORD
FLAP DEFLECTED 40 DEG.
ANGLE OF ATTACK, 11.2 DEG.
q = 15.82 UNITS
IMPACT PRESSURE LEVEL, 15 UNITS
REYNOLDS NUMBER, 6.15x10^6
C_N = 2.781
C_m c/4 = -.552
Upper surface
Lower surface
NACA
1/1000 units of C_q
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
1.1
1.2
x/c

Figure 16

Abbott, Ira H.

AUTHOR(S)

DIVISION: Aerodynamics (2)
SECTION: Wings and Airfoils (6)
CROSS REFERENCES: Pressure distribution - Wings (74500); Wings - Aerodynamics (99150)

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| U.S. | Eng. | | Unclas. | Jan '42 | 18 | 16 | graphs |

ABSTRACT

Wing pressure distribution diagrams for several angles of attack and flap deflections of 0°, 20°, and 40° are presented. The normal force coefficients agree with lift coefficients obtained in previous test of the same model, except for the maximum lifts with flap deflection. Pressure distribution measurements were made at Reynolds Number of about 6,000,000.

NOTE: Requests for copies of this report must be addressed to: N.A.C.A., Washington, D. C.

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